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IMPROVED DROUGHT MONITORING WITH NASA SATELLITE DATA

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Drought is among the most difficult of all natural hazards to monitor effectively and consistently because it has varying impacts in different sectors (e.g., agriculture, water supply), a subtle arrival and departure, and large spatial and temporal variability from drought to drought. The U.S. Drought Monitor (USDM) is an operational drought monitoring system and the primary national scale tool for current drought decision support (<http://drought.unl.edu/dm/monitor.html>).

Two major limitations in the current U.S. drought monitoring effort have been identified. The first is the coarse level of spatial detail at which analyses are performed and results delivered. The second is the lack of detailed, accurate, and objective data sources especially where current networks of weather stations are sparse, such as in the public lands of the West. These factors represent the two largest impediments to early detection of drought and its impacts at the county level, which is where key drought decision making takes place.

NASA's Applied Sciences Program for water resources is funding an effort with the Jet Propulsion Laboratory (JPL) and the US Geological Survey (USGS) to address these two major impediments. The objective of this project is to assimilate hydrologic and ecologic observations from NASA Earth satellite sensors, including the Advanced Microwave Scanning Radiometer – Earth Observing System (AMSR-E), the QuikSCAT/SeaWinds Scatterometer (QSCAT), and the Moderate Resolution Imaging Spectroradiometer (MODIS), into a national drought monitoring system, specifically the existing national decision support tool, USDM, used for drought monitoring and drought early warning.

The USGS EROS Center, in collaboration with the National Drought Mitigation Center (NDMC), has developed a hybrid drought indicator known as the Vegetation Drought Response Index (VegDRI) that incorporates NASA satellite observations, climate data, and biophysical indicators. In 2009, the VegDRI (incorporating MODIS imagery) was tested by USDM authors, including Mark Svoboda, a climatologist at the NDMC. They found the VegDRI to meet the finer resolution needs of the USDM along with the

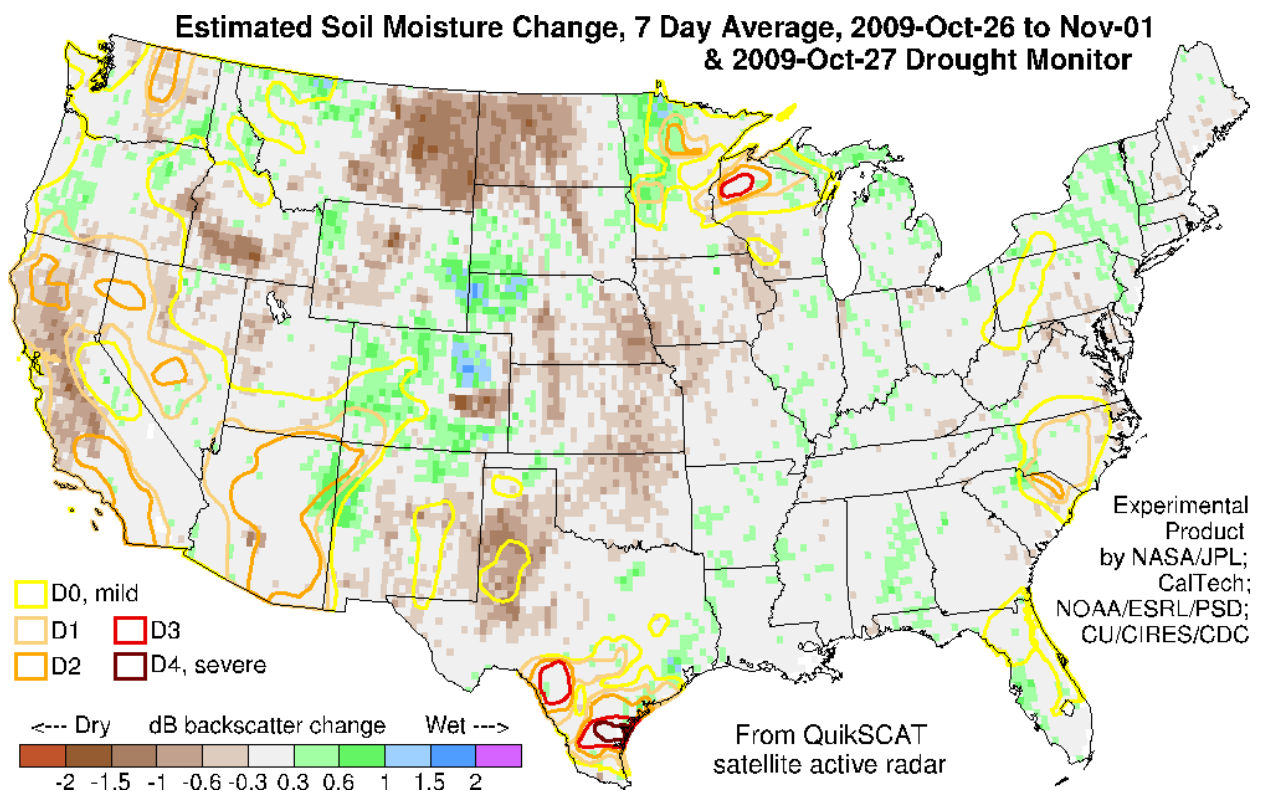
potential for addressing the regional scale needs of the National Integrated Drought Information System (NIDIS).

False rains due to anomalous propagation (AP) problems in radar meteorology or due to virga (dry rain, dry thunderstorms, etc.), especially in the western U.S., may prematurely decrease drought severity level or inappropriately terminate drought conditions in drought monitoring assessments. The Jet Propulsion Laboratory develops a unique product of soil moisture change (SMC) from QSCAT satellite scatterometer data. SMC represents rainwater that actually reaches to land surface and makes the soil wet. Therefore, SMC is directly relevant to drought monitoring, circumventing problems of virga and serious AP errors.

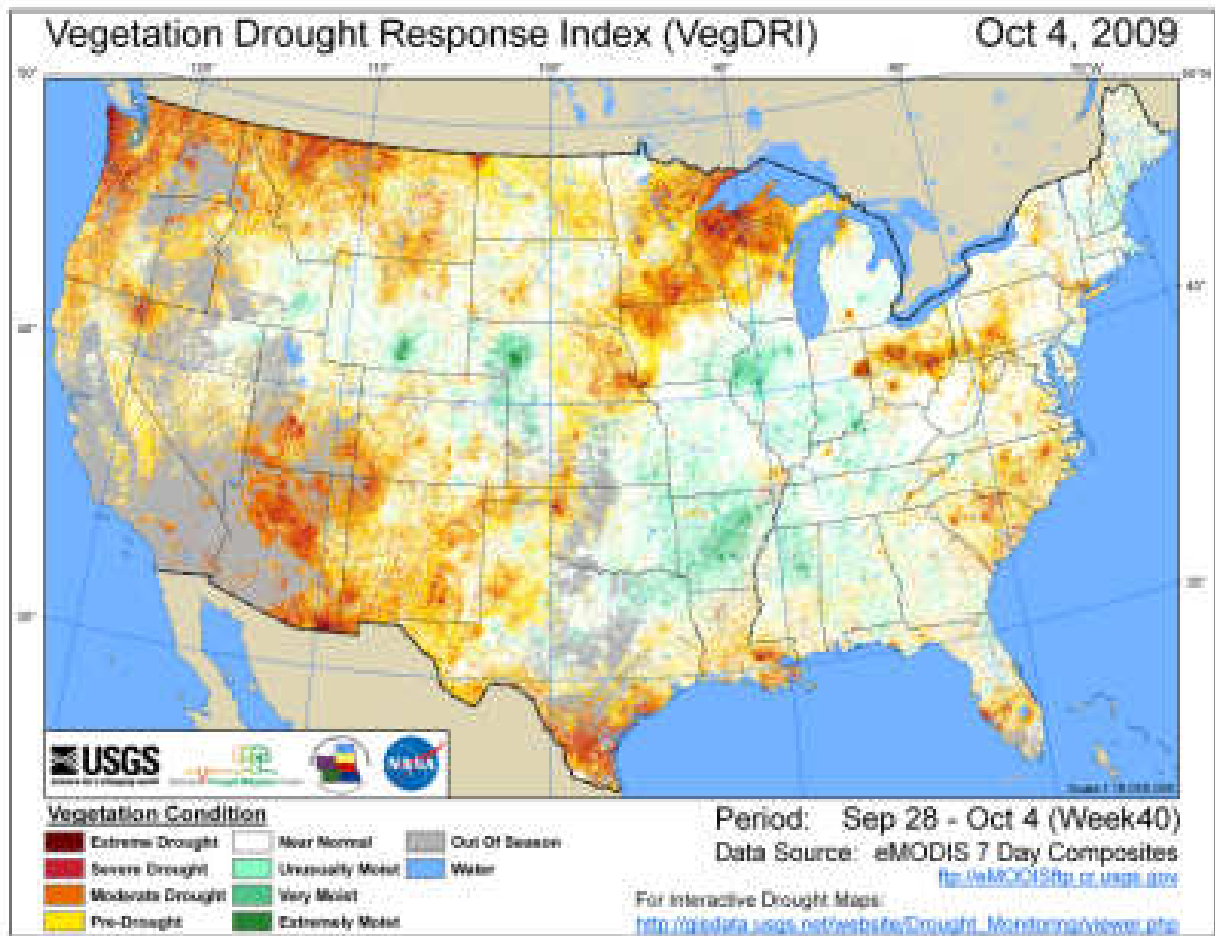
SMC is more representative of hydrological conditions while VegDRI accounts more for the ecological component. Therefore, these products provide a synergistic characterization and thus better assessments for drought monitoring than does each single product as a stand-alone parameter.

The following figures illustrate the enhanced national drought monitoring system products from hydrologic and ecologic observations from the NASA satellite data.

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The seven day change in soil moisture estimated from QuikSCAT data



NASA MODIS satellite data are updated in near real time to provide drought information at the county level and finer.

This article is one of a regular series of reports on emerging and innovative technologies in the area of environment and water resources produced by EWRI's Emerging and Innovative Technologies Committee (EITC). If you are interested in contributing an article please contact Sean McKenna (samcken@sandia.gov). For information on becoming a member of this Committee, please contact Laurel Saito (lsaito@cabnr.unr.edu).